Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Price Cap Performance Review	)	CC Docket No. 94-1
for Local Exchange Carriers	)	

GTE's REPLY COMMENTS

GTE Service Corporation and its affiliated domestic telephone operating companies ("GTE") hereby submit responses to comments on the Commission's Fourth Further Notice of Proposed Rulemaking ("*Fourth Notice*"), FCC 95-406 (released September 27, 1995), in the proceeding captioned above with respect to the structure of the price cap formula for Local Exchange Carriers ("LECs" or "exchange carriers").

INTRODUCTION

The Price Cap Index ("PCI") adjustment formula is the heart of price cap regulation. It is the transition mechanism from a noncompetitive to a competitive environment. The Commission uses the price cap formula to mimic the way a competitive industry determines output prices. In a competitive market, the percentage output price change should equal the percentage change in input prices minus the percentage change in productivity.

Firms in the industry are forced to adjust to these price changes. Those that do not adjust lose money and — if they do not go out of business (such as Pan Am, Braniff and Eastern) — they are eventually replaced or reorganized with new, presumably more efficient, management. This is what is meant by a competitive pricing discipline. Failure to

respond to output price changes leads to business failure, even bankruptcy. Thus, in the *Fourth Notice*, the Commission seeks comment on how it should structure the price cap formula until such a time as it is no longer necessary.

Concentrating on the X-Factor, the Commission (*Fourth Notice* at ¶16) has determined that this factor should:

1. Be economically meaningful in that it is a reliable measure of the extent to which changes in LECs' unit costs have been less than the level of inflation;
2. Ensure that ongoing gains by the LECs in reducing costs are passed through to consumers; and
3. Be the result of a reasonably simple calculation that is based on accessible and verifiable data.

These points reflect the consensus of commenting parties. What is widely debated is how the X-Factor should accomplish these objectives. The majority of parties agree with the Commission (*Fourth Notice* at ¶25) that a Total Factor Productivity ("TFP") methodology is the best means of measuring LEC productivity.[1] Divergence arises concerning the factors used in executing such a methodology. GTE will demonstrate that the simplified TFP model developed by Christensen Associates ("Christensen") and put on the record by the United States Telephone Association ("USTA") is the most appropriate method available to develop

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[2] Of the 22 parties commenting, 19 are willing to accept a TFP methodology as the most appropriate method of calculating productivity, given that their particular concerns are addressed. For example, MCI (at 8) and the Telecommunications Resellers Association ("TRA") (at 5) condition their acceptance of TFP on the ability to measure only interstate TFP. The American Petroleum Institute ("API") will accept TFP if only interstate TFP can be measured and other firms are included. Those parties that do not support TFP give as reasons the complexity of the TFP methodology and their preference for earnings-based regulation. See General Services Administration ("GSA") at 4 and International Communications Association ("ICA") at 7.

TFP.[2] The major concerns expressed by the Commission[3] and other parties — public availability, timeliness, and auditability of data — have been addressed in Christensen's simplified TFP model. Christensen's methodology is consistent with numerous other productivity studies, including that used by the Bureau of Labor Statistics ("BLS") to calculate US TFP.

Opponents of Christensen's TFP methodology claim that it does not include an input price differential (W-Factor), thus making it invalid. The criticism is misdirected. $\%\Delta TFP_{LEC}$ is simply one component of a properly constructed PCI. Christensen's methodology produces a TFP and a separate estimate of LEC inflation. The issue of the W-Factor arises because of an attempt to approximate the LEC input price inflation rate using an economy-wide estimate of input inflation, $\%\Delta GDPPI\text{-}\%\Delta TFP_{US}$. If LEC input prices move the same way as input prices for the economy as a whole, then one may use $\%\Delta GDPPI\text{ -}\%\Delta TFP_{US}$ as an approximation to the input price component of the formula. But, $\%\Delta GDPPI\text{ -}\%\Delta TFP_{US}$ has nothing to do with the calculation of the TFP_{LEC} component.

It is true that a residual of the TFP methodology is an input price series that could be used to determine LEC input prices, but it is important not to confuse the calculation of TFP_{LEC} with the approximation used for LEC input prices: $\%\Delta GDPPI\text{-}\%\Delta TFP_{US}$. If the Commission decides that $\%\Delta GDPPI\text{-}\%\Delta TFP_{US}$ does not accurately represent LEC input price changes, then it should use the input price series produced as a result of Christensen's TFP study and adopt as a direct measure of the PCI adjustment factor a

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[2] See Comments of the United States Telephone Association ("USTA's Comments"), Attachment A, dated January 16, 1996, in the instant proceeding.

[3] *See Fourth Notice* at ¶¶17-21.

properly forecasted estimate of the percent change in LEC input prices less the percent change in the LEC TFP. A direct measure negates any concerns about an input price differential.

The other major difference placed on the record is the relevance of calculating an interstate-only TFP. The methods advocated to calculate an interstate TFP are not economically meaningful in that they do not, and cannot isolate, interstate inputs. They rely solely on arbitrarily derived interstate outputs to determine an interstate TFP.

DISCUSSION

I. CHRISTENSEN'S SIMPLIFIED TFP MODEL ADDRESSES ALL VALID CONCERNS RAISED BY THE COMMISSION AND OTHER PARTIES.

A. The simplified model uses publicly available, timely, and auditable data and incorporates an equity component in the cost of capital.

The Commission's concerns (*Fourth Notice* at ¶¶17-21) regarding the public availability, timeliness, and auditability of data have been accommodated in Christensen's simplified model.[4] USTA's Comments (Attachment B) contain a TFP Review Plan ("TFPRP") that lists in detail all sources for the data used in the simplified model. The changes to publicly available data include: (i) the use of booked revenues from ARMIS 4302 reports[5] instead of billed revenues; (ii) investment price indexes published by the US Bureau of Economic Analysis ("BEA") instead of LEC-specific Telephone Plant Indexes ("TPIs"); (iii) beginning-of-year 1988 book values found in the ARMIS 4302 reports instead

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[4] These same concerns were expressed by Ad Hoc's consultant Economics and Technology, Inc. ("ETI") at 5-13, and AT&T's consultant Dr. John Norsworthy ("Norsworthy"), Appendix A at 3-6, ICA at 6, TRA at 4.

[5] The ARMIS 4302 report replaced the Form M that was previously required.

of the 1984 current cost of gross plant; and (iv) total employees from ARMIS 4302 reports instead of an index of management and nonmanagement hours. A detailed examination of the TFPRP demonstrates that all sources of data are now publicly available, timely, and auditable.

Christensen replaced Moody's average yield on public utility bonds — which was criticized because it included only a debt component — with the US National Income and Product Accounts cost of capital, a measure that reflects both debt and equity. It is important to point out that, although Moody's was used in the original study in the rental price equation, the absence of an equity component has little if any effect on TFP. It is only the input price series that is affected by the equity component. Therefore, the use of Moody's did not distort the calculation of exchange carrier TFP in the original study. The criticisms levied at Christensen for the use of Moody's would only be valid if the input price series produced as a result of the TFP study was intended to be part of the price cap formula — which it was not. In any case, these criticisms have been dealt with by Christensen's simplified model.

The majority of the changes incorporated in ETI's rework of Christensen's TFP study have already been made by Christensen in the simplified model. Thus, ETI's concerns (at 8) about the use of TPIs and the 1984 capital stock data have been addressed. As recommended by ETI (at 25), Christensen's simplified TFP model uses, in place of the 1984 capital stock data, "historical cost data, and specifically the net book value of plant in service" which "is available in ARMIS." Further, as recommended by ETI (at 26), Christensen's simplified model uses alternative price deflator data available from public sources (the BEA) instead of exchange carrier proprietary TPIs. Both ETI (at 19) and

Norsworthy (Appendix A at 82) imply that Christensen did not correctly calculate taxes because Moody's does not contain an equity component. In fact, Christensen used actual taxes paid by the LECs; contrary to the implications of ETI and Norsworthy, the absence of a debt/equity ratio did not impact this calculation. In any case, as stated *supra*, the simplified model now uses the US National Income and Product Accounts cost of capital, which reflects both debt and equity.

B. Other criticisms of Christensen's methodology do not invalidate the simplified model.

GTE will discuss *infra* other changes proposed by Norsworthy and ETI. But, before discussing these changes, GTE stresses that *the resulting $\%\Delta TFP_{LEC}$ of all three studies, when done on a total company basis, is essentially the same.*

	Christensen	Norsworthy	ETI
Time Period	1989-1994	1985-1994	1984-1993
LECs Studied	11	7[6]	9
$\%\Delta TFP_{LEC}$	3.07%	3.01%	3.2%

ETI's result is almost the same as Christensen's because: (i) ETI used Christensen's original study as a basis; and (ii) most of the changes recommended by ETI have already been incorporated into Christensen's simplified model. The fact that Norsworthy's method produces almost the same result as Christensen's is because the combination of competition and regulatory action has been effective in keeping prices near

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[6] Since Norsworthy (Appendix A at 67) states that his Performance-Based Model is similar to AT&T's model previously submitted, GTE concludes that the same companies; *i.e.*, the RBOCs, constitute the study.

marginal costs. It also results from the fact that TFP is a relatively robust measure where small changes in data do not much affect it.

The extreme X-Factors that AT&T (at 39) and Ad Hoc (at 4) advocate result from: (i) manipulation of the data to arbitrarily derive an interstate TFP; (ii) the addition of a fixed, positive input price differential; and (iii) the addition of a CPD. All of which are totally unwarranted as will be discussed *infra*.

1. Revenue Weights versus Marginal Cost Weights

As GTE states in its comments, and as ETI (at 31) points out, the point of price cap regulation is to find a cap that behaves like prices in a competitive market. In a competitive market, a *specific* index of output prices may be written as the difference between a *specific* index of input price growth and a *specific* index of growth rates of outputs and inputs. Since the point of price cap regulation is to make the price cap behave as it would under competition, the *specific* indexes that would be found under competition are the ones to use on a going-forward basis — those used by Christensen. In contrast, Norsworthy would have the Commission use indexes that are relevant for mimicking the behavior of prices of rate-of-return regulated monopolies, by replacing the indexes that are appropriate to competition with those that are relevant for a monopoly.

GTE has demonstrated that in a competitive market, a **revenue share** weighted average of output price growth rates is identical to the difference of a **cost share** weighted average of input price growth rates and an index that looks like the growth rate for a TFP for a competitive firm that was initially structured like the monopoly. That is, the index the Commission should use is not a TFP for the monopoly, but the TFP structured as if the firm operated in a competitive market.

The productivity index relevant for a competitive firm is a **revenue share** weighted average of output growth minus a **cost share** weighted average of input growth. This difference, for a competitive market, is the TFP for the industry. It is this TFP that one would expect to find in a noncompetitive market effectively regulated to behave competitively. Thus, it is the correct TFP to use in a price cap. Specifically, under competition the economically valid PCI adjustment factor is:

$$\%\Delta P_{LEC}=\%\Delta W_{LEC}-\%\Delta TFP_{LEC}+/-Z$$

where $\%\Delta P_{LEC}$ is the PCI adjustment factor, $\%\Delta W_{LEC}$ is the cost share weighted average of percentage input price changes, and $\%\Delta TFP_{LEC}$ is the industry TFP growth rate in percentages.

Moreover, the appropriate measure of TFP growth is that for a competitive industry,

$$\%\Delta TFP_{LEC}=\%\Delta OUTPUTS_{LEC}-\%\Delta INPUTS_{LEC}$$

where $\%\Delta OUTPUTS_{LEC}$ is a revenue share, not marginal cost share, weighted average of output growth rates. And $\%\Delta INPUTS_{LEC}$ is a cost share weighted average of input growth rates.

Why not marginal cost weights? Because the purpose of the price cap formula is to make the LECs behave competitively, not monopolistically, as might be expected if a TFP appropriate for a monopoly (*i.e.*, one with marginal cost weights) were employed. As discussed *supra*, Norsworthy's method produces almost the same result as Christensen's because the combination of competition and regulatory action has been effective in keeping prices near marginal costs. It also results from the fact that TFP is a relatively robust measure, *i.e.*, not much affected by small changes in data.

However, one should never count on serendipity; the fact that the results are close here does not mean they will always be. GTE submits that Norsworthy's use of marginal cost weights is inappropriate for the measurement of TFP in a price cap formula, while Christensen's use of revenue weights appropriately recognizes the purpose of TFP in the price cap formula — that of mimicking competition.

2. Opportunity Cost of Capital versus Rate of Return on Investment

Norsworthy's Performance-Based Model uses achieved accounting rate of return on investment as the opportunity cost of capital and regulatory accounting measures in lieu of economic measures.[7] Basically, Norsworthy's model is not a TFP study, but a thinly disguised Historical Revenue methodology. In trying to discover how a monopoly would behave in a rate-of-return world, he develops measures that would force exchange carriers back into an inefficient rate-of-return type of behavior. Had he understood the context in which TFPs were being introduced into the PCI adjustment factor, GTE would hope that he would see that competitive-type TFPs, economic depreciation, and economic costs — rather than monopoly and rate-of-return-based measures of TFP, costs, and depreciation — should form the basis of a PCI that imposes a competitive-type price discipline on the market.

Norsworthy's use of accounting returns, depreciation, and book value of plant does not equate to an economic measure of the cost of capital. Accounting returns simply do not reflect economic returns. In using the accounting return to determine the cost of capital, Norsworthy's price of capital would fluctuate based on any change in measured earnings

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[7] Norsworthy, Appendix A at 70.

whether or not it had any impact on the opportunity cost of capital.[8] The Commission must examine with great skepticism Norsworthy's determination of the cost of capital and his use of it in the Performance-Based Model. Again, using measures based on noncompetitive outcomes is unlikely to produce competitive results on an ongoing basis. Only by using measures based on what would happen under competition will the essential competitive market pricing discipline, and all its benefits, be achieved.

3. Economic versus Prescribed Depreciation Rates

Economists measure depreciation based on the replacement cost of assets — not the original or accounting cost. Further, economic depreciation is the only meaningful base for computing capital stocks. While depreciation does not have much of an effect on the calculation of TFP — the TFP being quite robust in relation to data errors — the same cannot be said for input price indexes. Consequently, the problem with Norsworthy's and ETI's approach comes in its effect on the computation of the LEC input price index. Moreover, the role of the input price index in the PCI is quite explicit. It measures the effect of changes in input prices purchased in an external competitive market; as such it is outward-looking and measures the external effects of input price changes on the firm.[9] Consequently, the relevant measure is one based on economic costs, economic depreciation, and economic costs of capital. It is inconceivable that prescribed depreciation

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[8] GTE incorporates by reference the National Economic Research Associates' ("NERA's") detailed explanation of the flaws in Norsworthy's Performance-Based Model. *See* Reply Comments of the United States Telephone Association, Attachment B in the instant proceeding ("USTA's Reply Comments").

[9] The TFP is more of an inward-looking measure that answers the question of how changes in technology, rather than the market, impact output prices.

schedules will mimic the operation of a competitive market undergoing vast technological restructuring.

Accounting depreciation is simply a place holder in an account. It has no economic reality except to the extent that economic decisions based on it distort any otherwise rational decision based upon it. It is as though one has a compass that might as easily be pointing North, East or West; one should not rely on it; and to depend on this unreliable compass in preference to a reliable one would be doubly foolish.[10]

In addition to overwhelming evidence that economic depreciation is the relevant measure, the Commission should be moving away from prescribing depreciation rates in order to better carry out Congressional intent. Section 403(d) of the Telecommunications Act of 1996, which changes 47 U.S.C. Section 220(b) to read "may prescribe, for such carriers as it determines to be appropriate," gives the Commission flexibility to dispense with depreciation prescriptions shown to be unnecessary. Further, the Commission's Draft Implementation Schedule for S.652, "Telecommunications Act of 1996," lists as Issue 27 a proceeding in 1997 to address the statutory requirement. Prescribed depreciation rates are necessary for price cap LECs because of the sharing mechanism. If the Commission truly believes that "the sharing mechanism deprives LECs and their customers of the full benefits of lower prices and improved efficiency,"[11] it will eliminate sharing; then prescribed

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[10] GTE incorporates by reference the Technology Futures Inc. ("TFI") analysis of the inadequacy of currently prescribed depreciation rates. *See* USTA's Reply Comments, Attachment D in the instant proceeding.

[11] *Price Cap Performance Review for Local Exchange Carriers*, CC Docket No. 94-1 ("D.94-1"), First Report and Order, 10 FCC Rcd 8961, 9047 (1995) ("*First Report and Order*") *(subsequent citations omitted).*

depreciation rates would be no longer required. A sound economic perspective supports Commissioner Chong's suggestion that "it may be a worthy public interest goal to end depreciation prescriptions at the FCC as we close out the twentieth century."[12] Under a moving average scenario — or any other scenario that incorporates new data on a forward-going basis — it would be infeasible to use prescribed depreciation rates that most likely will soon end.

4. BEA Indexes versus Hedonic Price Indexes

There are basically two methods for computing TFP, a parametric or econometric approach and a nonparametric approach. Christensen, among others, pioneered the econometric method, yet eschews it here for the simple reason that the nonparametric method provides the information needed to guide a PCI adjustment factor, and because it is well known that the nonparametric approach is quite robust, *i.e.*, quite insensitive to corrections or errors in data. Moreover, the nonparametric method does not require exhaustive data as does Norsworthy's method.

Norsworthy would have the Commission go about it a different way, first by calculating an econometric production function or cost function, then by calculating from that the TFP. In short, Norsworthy would have the Commission go the long way around to obtain essentially the same thing (assuming it is done correctly).

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[12] *See* Separate Statement of Commissioner Rachelle B. Chong, *Re: The Prescription of Revised Percentages of Depreciation pursuant to the Communications Act of 1934, as amended, for Alascom et. al - Memorandum Opinion and Order*, dated January 26, 1996.

As Christensen notes,[13] Norsworthy's hedonic indexes are based on unpublished research and do not meet the Commission's standard of accessible and verifiable data.[14] Moreover, Norsworthy's methodology is not generally accepted by the economic community. At best, it is currently an area of ongoing speculative research that has produced few results after many years of work. In addition, as the BEA and BLS update their indexes to reflect any quality changes, the TFP would incorporate these changes on an ongoing basis. Probably most revealing is a quote from Norsworthy and Jang:

> There are two main approaches to measuring the growth of TFP. One method [the one used by Christensen in this proceeding] expresses TFP as the ratio of unadjusted output to unadjusted inputs, and treats such factors as quality change ... as factors explaining growth in TFP. The chief alternative method [the one proposed by Norsworthy in this proceeding] is to adjust inputs and/or outputs or neither for quality change .... On a purely methodological basis, either method is acceptable. However, as noted in Chapter 1, the first mentioned approach [Christensen's] is preferred on practical grounds ....[15]

5. Treatment of OPEBs and Early Retirement Plans

ETI (at 28) and Norsworthy (Appendix B at 15) attempt to convince the Commission that labor is incorrectly reflected in the Christensen study because the impact of Other Postretirement Employee Benefits ("OPEBs") and other one-time events (*e.g.*, early

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[13] *See* USTA's Reply Comments, Attachment A at 17.

[14] ETI (at 57) does not attempt to perform a detailed adjustment for hedonic effects. but *arbitrarily* applies a ten percent downward adjustment to the asset price deflators for central office switching and the computer component of general support equipment.

[15] Norsworthy, J. R. and S. L. Jang, *Empirical Measurement and Analysis of Productivity and Technological Change: Applications in High Technology and Service Industries*, North Holland, 1992, at 229-230.

retirement plans) are actually reflected in the year in which they occur. ETI wants these expenses amortized over some period of years instead.

GTE, as well as other LECs, follow Generally Accepted Accounting Principles ("GAAP") and the guidelines established by Responsible Accounting Order ("RAO") 24 regarding the booking of accruals for workforce reductions, Financial Accounting Standards ("FAS") 88 for curtailments, and FAS 87 for pensions. Annual inputs and outputs, as they occur, should be reflected in a TFP study. To suggest that labor, and only labor, be reflected differently than all other inputs is not only inappropriate, but inconsistent. Nowhere does ETI recommend allowing the LECs to amortize expenses for any other category — or for revenues.

The Commission should not accept Norsworthy's or ETI's suggestion that one, and only one, input be treated differently — a methodology that would produce a better near-term result for those parties' clients. ETI's recommendation that certain labor expenses be amortized over many years is not only incorrect treatment of a particular input price series, but designed to create a higher X-Factor in the near-term. GTE does not endorse the manipulation of inputs or outputs to produce a specific near-term beneficial result for any party. GTE does support smoothing a volatile series that could create pricing instability, such as the exchange carrier input price series, but any necessary smoothing should be accomplished in a manner reminiscent of expectation formation in a competitive market — that is, via a forecasting method or moving average.

6. Christensen's methodology is widely accepted by productivity experts.

Dr. Selwyn (ETI) and Dr. Norsworthy (AT&T) attack the credibility and competence of Dr. Christensen — who invented a great majority of the productivity literature to which

everyone in this proceeding appeals. ETI (at 2, 7-10, 28, 34, 44) constantly refers to the State of California's price cap proceeding and even Norsworthy (Appendix A at 30 and 77) refers to Dr. Selwyn's testimony in California as if were an accepted point of view. In fact, the California Public Utilities Commission ("CPUC") summarily dismissed Dr. Selwyn's arguments and accepted the analysis of Dr. Christensen. In its decision, the CPUC made the same comparison that this Commission will have to do: of the credibility of Selwyn's extreme, unsubstantiated position and Christensen's reasoned analysis. The CPUC came down clearly and loudly for Christensen.

> Our previous discussion of the impacts of the "X" factor make it clear that a "stretch" factor is no longer appropriate public policy. Finally, although we find the arguments of Dr. Selwyn on "input price differentials" theoretically interesting, we conclude that there is no basis for concluding that an empirical input price differential will exist in the next three years, or that it exists today.[16]

Christensen is a world-renowned expert on the issues of productivity measurement and price index construction. Indeed, he is a general economist of the first tier. In contrast, neither Selwyn nor Norsworthy is considered a leading authority in the area of productivity measurement and price index construction. Christensen's methodology is widely accepted and used, and forms the basis of all the commentary from all of the parties. Similarly, other commenters supporting Christensen — Dr. Gollop,[17] Dr. Fuss,[18] Dr. Taylor, Dr. Tardiff, and

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[16] *See* Public Utilities Commission of the State of California, I.95-05-047, Interim Opinion, Decision 95-12-052, December 20, 1995, at 67.

[17] *See* Comments of BellSouth Telecommunications, Inc., Attachment 1.

[18] *See* Comments of Bell Atlantic, Declaration of Melvin A. Fuss.

Dr. Zarkadas (NERA),[19] and Dr. Duncan[20] — all have major academic and professional reputations; they are all well published and have major citations.[21]

On the other hand, Dr. Selwyn and Dr. Norsworthy take extreme positions — in reference to the majority of the economists commenting in this proceeding — regarding the econometric methods that best validate the correct value of the input price differential in the price cap formula and the appropriate measures for calculating TFP. Their positions deviate significantly *vis-à-vis* mainstream economic methods.

While GTE assumes a good faith effort on Norsworthy's part to aid the Commission in making its decision, the Commission should be wary of his arcane methodologies. Specifically, the Commission should view skeptically Norsworthy's hedonic quality adjustments where simpler mainstream methodologies, such as nonparametric TFP, will account for the same factors at a fraction of the cost and effort. In addition, the mainstream techniques are more stable and robust against error and misspecification, as well as being generally accepted by the profession.[22]

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19 *See* USTA's Comments, Attachment C.

20 *See* GTE's Comments, Appendix F.

21 Interestingly, almost all of the aforementioned are referred to in Norsworthy, J. R. and S. L. Jang, *Empirical Measurement and Analysis of Productivity and Technological Change: Applications in High Technology and Service Industries,* North Holland, 1992.

22 Misspecification is a particularly serious problem with econometric productivity analysis. Indeed, Norsworthy gives a fair account of some of the problems in his monograph, Norsworthy, J. R. and S. L. Jang, *Empirical Measurement and Analysis of Productivity and Technological Change: Applications in High Technology and Service Industries,* North Holland, 1992. *See* also Chambers, R.G., *Applied Production Analysis*, Cambridge University Press: New York, 1988.

In summary: Christensen is a recognized expert on productivity and his methodology is widely accepted and used. Christensen's simplified TFP methodology and model placed on the record by USTA addresses all valid concerns voiced by the Commission and other parties. Proprietary data has been eliminated and all the data used in the simplified model is publicly available, auditable, and timely. In addition, the US National Income and Products Accounts cost of capital, which includes both a debt and equity component, is now used in place of Moody's average yield on public utility bonds.

Alternate suggestions put forth by various parties have been shown not to be warranted. In a PCI designed to mimic the behavior of a competitive industry, the output component of the TFP change should use revenue weights, not marginal cost weights. The opportunity or economic cost of capital is the measure that should be used in a TFP study because this is the measure that a competitive market uses — not accounting return. To replace the opportunity cost of capital in a TFP study with accounting returns takes the price cap LECs back to rate-of-return regulation. Similarly, using prescribed depreciation rates, instead of economic depreciation rates, misses the Commission's stated goal of economically meaningful measures and, once again, does not reflect how a competitive market operates.

The argument for the use of hedonic indexes is futile at this point; a well-accepted methodology for their construction does not exist, and even if it did it would be unlikely to improve the measure of changes in the PCI that are the result of non-price changes. Indeed, the effect of such changes are already reflected in the industry indexes used by Christensen. The percent growth of exchange carrier TFP and input prices should be measured based on actual inputs and outputs for all measures and not adjusted solely to

smooth the labor input series. Any smoothing should be accomplished via a forecasting method or moving average.

II. ADOPTION OF A DIRECT MEASURE OF LEC INPUT PRICES LESS LEC TFP ELIMINATES THE CONTROVERSY OVER AN INPUT PRICE DIFFERENTIAL.

A. The price cap formula needs to be simplified — not further complicated by the addition of an input price differential.

In originally establishing the price cap formula, the Commission recognized that in competitive markets, a revenue-share-weighted average of industry output price growth *(%ΔP)* will equal a cost-share-weighted average of the industry input price growth *(%ΔW)* minus the rate of change of industry total factor productivity *(%ΔTFP)*, plus or minus exogenous factors that would ordinarily effect changes in output prices (the so-called exogenous or Z-Factor) or

$$\%\Delta P=\%\Delta W-\%\Delta TFP+/-Z.$$

At that time no input price index existed for exchange carriers. The Commission ascertained that the percent change in LEC input prices ($\%\Delta W_{LEC}$) was similar to the percent change in US input prices ($\%\Delta W_{US}$), and sought to use such a measure. Since a US input price index did not exist either, it was approximated using the formula

$$\%\Delta GDPPI=\%\Delta W_{US}-\%\Delta TFP_{US}$$

or

$$\%\Delta W_{US}=\%\Delta GDPPI+\%\Delta TFP_{US}.$$

Therefore, the price cap formula became

$$\%\Delta P_{LEC}=(\%\Delta GDPPI+\%\Delta TFP_{US})-\%\Delta TFP_{LEC}$$

or

$$\%\Delta P_{LEC}=\%\Delta GDPPI-(\%\Delta TFP_{LEC}-\%\Delta TFP_{US})$$

where the X-Factor is $(\%\Delta TFP_{LEC}-\%\Delta TFP_{US})$.

The Commission now has tentatively concluded that $\%\Delta W_{US}$ is not a valid approximation for $\%\Delta W_{LEC}$[23] and questions whether it is better to incorporate an input price differential $(\%\Delta W_{US} - \%\Delta W_{LEC})$ into the X-Factor or if it is time to return to a direct measure of the percent growth in LEC input prices less the percent growth in LEC TFP.[24] Surely the Commission must recognize that:

$$\%\Delta P_{LEC} = \%\Delta W_{LEC} - \%\Delta TFP_{LEC} +/- Z$$

is a simpler and less controversial formula than

$$\%\Delta P_{LEC} = \%\Delta GDPPI - ((\%\Delta TFP_{LEC} - \%\Delta TFP_{US}) + (\%\Delta W_{US} - \%\Delta W_{LEC})) +/- Z$$

since each component of each formula will undoubtedly be the source of much controversy. Moreover, the latter formula requires the computation of at least three more indexes than the former, and presumably theoretically equivalent, formula.

GTE agrees with Sprint (at 8) and Ameritech (at 5-6) that it is time to simplify the price cap formula by removing economy-wide data and concentrating solely on the exchange carriers.[25] Even ETI recognizes (at 43) that "a telecommunications-specific input price index would have the potential of solving many of the issues." GTE submits that a formula using direct measures would incorporate all available information concerning LEC

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23 *See Fourth Notice* at ¶54.

24 *Id.* at ¶61.

25 BellSouth (at 16) premises its acceptance of a direct measure on the Commission using a sufficiently long period of time to reduce the volatility in the LEC input price series. Lincoln (at 7-8) also addresses concerns regarding the pricing instability of using a direct measure without sufficient time to smooth the volatility in the input price series. GTE will address this *infra*.

input prices, without imposing any judgment as to whether a differential exists. This approach would eliminate the controversy over the input price differential.

B. Christensen's simplified TFP model produces a LEC-specific input price series.

A requirement for the proper calculation of the PCI adjustment factor using direct measures is a LEC input price series. An error-free input price measure does not exist; what exists is various estimates — two of which have been debated in this proceeding. The first is a direct measure of LEC input price growth, calculated by Christensen. The second is a proxy, $GDPPI\text{-}TFP_{US}$, which is an estimate of the input price growth of the US as a whole. Using the data in Appendix F of the *First Report and Order*, Dr. Duncan showed that there is no evidence that the two series differ.[26] This is consistent with the hypothesis that the US input price growth index and the LEC input price index measure the same underlying change in the input prices facing LECs.

ETI (at n.105) claims that Dr. Duncan's empirical tests suffer from the same infirmities as those performed by Christensen and NERA — the use of a long-run data series. In fact, no infirmities have ever been uncovered in any of the studies showing no difference between the series. Moreover, Dr. Duncan tested the hypothesis that the two series used by Bush/Uretsky in fact measured the same underlying change in input prices. Using exactly their data and a battery of different statistical methods, Duncan showed that there is absolutely no evidence that deviations between the series are anything but random noise. That is, the decision of which one to use is a matter of which series can be developed to yield the more competition-like PCI.

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[26] See GTE's Comments, Appendix F.

In GTE's opinion, either series can be used; however, the PCIs based on the LEC input price series require more statistical manipulation to eliminate random errors than does the GDPPI-X formulation. The strong qualification on this is that the X-Factor must contain no input price differential.

ETI's claim (at n.105) that Dr. Duncan's analysis suffered "infirmities" is wrong. Indeed, Dr. Duncan found significant errors in the Bush/Uretsky analysis that render it useless. Specifically, Bush/Uretsky do not test the hypothesis that the two series differ, but investigate whether the relationship between the LEC input price index, the US input price index, and the Moody's Bond index change in the same way. It is a hypothesis that has no bearing on whether the US input price index and the LEC input price index measure the same underlying change in LEC input prices, nor does it address the question of which one should be used if they do measure the same thing.

ETI (*id.*) would seem to characterize Dr. Duncan's analysis as being technically correct but applied to the wrong data. However, Dr. Duncan applied his methodology to exactly the same data as used by Bush and Uretsky. Indeed, the data were taken from Appendix F of the *First Report and Order*. Finally, Dr. Duncan directly tested the hypothesis that the relationship between the two price indexes differed on a going-forward basis after 1984, as proposed by Bush/Uretsky. He was able to reject their hypothesis out-of-hand. His analysis of the Bush/Uretsky analysis showed that irrecoverable technical errors in their analysis were the source of their erroneous conclusion.

Norsworthy's claim that the appropriate test is that the distributions of the two series are identical is absurd. No one claims either series is an error-free measure of the change in input prices; both suffer from random errors. The LEC input price series might be favored

because it is "closer" conceptually to the term required in the PCI adjustment factor ($\%\Delta W_{LEC}$); however, it is quite volatile. If the US input price series and the LEC series measure the same thing, then the less volatile one, which is $GDPPI\text{-}TFP_{US}$, might be preferred on that basis.

Norsworthy is either making a statistical mistake, or is engaging in obfuscation. His test is that the two series are distributionally identical; when in fact they are not. If they were identical, it would not matter which was used. The relevant questions are: First, do both series measure, with error, the underlying index required by theory? Second, if they do measure the same thing, which one does the best job of emulating the input price experience that the LEC industry would undergo if it were competitive?

$\%\Delta GDPPI\text{-}\%\Delta TFP_{US}$ has the advantage of being stable. An argument can be made that since input prices in the economy generally move together, $\%\Delta GDPPI\text{-}\%\Delta TFP_{US}$ should be a good proxy for LEC input price growth. The LEC input price growth index is quite a bit more volatile, but has the advantage of being based on LEC input prices. However, the components are weighted by weights that might be found in a regulated industry, rather than a competitive one.

As to the first question, do the series measure the same thing? Dr. Christensen, Dr. Duncan, and Drs. Taylor, Tardiff, and Zarkadas for NERA all find they do measure the same thing. The next question is which to use. GTE opted for using the LEC input price series directly and smoothing, by optimal forecasting, the resulting output price series to obtain a PCI that would behave like one in a competitive market. USTA has argued for using the already smoothed US input price growth series $\%\Delta GDPPI\text{-}\%\Delta TFP_{US}$.

Properly done, both amount to the same thing; the difference being in the same random variations in the input price series that make the series not identical. If the Commission determines that the two series do not measure the same thing, then Christensen's LEC input price series should be used exclusively, in the manner GTE suggests in its comments and discusses *infra*.

Christensen's TFP methodology produces an input price series. The Commission itself used Christensen's input price series in Appendix F of the *First Report and Order* as a basis for its tentative conclusion that an input price differential existed. As ETI (at 43) states, if the quality of Christensen's input data is acceptable for calculating TFP, then it should be acceptable for calculating input prices. GTE agrees with ETI. Further, the changes incorporated into Christensen's simplified TFP model result in a reasonably accurate representation of a LEC specific input price series.

Since the Commission previously accepted Christensen's input price series, as demonstrated in Appendix F of the *First Report and Order*, GTE recommends that it accept the input price series from Christensen's simplified model and adopt a direct measure of LEC input prices less LEC TFP — predicated on the period of time used to forecast a PCI adjustment factor being long enough to eliminate the volatility which could result in wide price swings from year to year.

In summary: The appropriate measure for the PCI adjustment factor is the percent change in growth of LEC input prices less the percent change in growth of exchange carrier TFP. The Commission should adopt this direct measure and eliminate all the controversy over whether or not an input price differential should be incorporated into a price cap formula that: 1) is already too complex; and 2) already contains approximations. The input

price series resulting from Christensen's TFP study has been accepted by the Commission as a valid measure of LEC input prices; therefore, the Commission should eliminate all the economy-wide measures from the formula and return to a direct measure.

III. THE COMMISSION MUST ENSURE THAT THE PCI ADJUSTMENT FACTOR IS OPTIMALLY PREDICTED AND THE PRICE CAP FORMULA CANNOT BE GAMED.

A. A forecasting method based on historical data is the best method to predict an annual PCI adjustment factor.

To vitiate the volatility of the LEC input price growth series in the PCI adjustment factor, GTE recommends forecasting the PCI adjustment factor based on actual past values of the difference $\%\Delta W_{LEC}$-$\%\Delta TFP_{LEC}$ and using the one-year-ahead forecast as the PCI adjustment factor. Christensen also states: "The key in developing a forward-looking X-factor is finding the best predictor of X — i.e., determining its expected value."[27]

Since many of the objections raised regarding a moving average would be equally applicable to a time series forecast, GTE will address these concerns. In advocating the use of a moving average for the X-Factor,[28] USTA correctly notes that incorporation of new data annually will adjust for changes in productivity — thereby reflecting the dynamics of LEC performance that would, in turn, flow-through recent productivity gains. This is also true for a time series forecasting method. Opponents of a moving average claim that it creates an administrative burden; they cite previous difficulties with the TFP data; and they claim that the LECs are cohesive and smart enough to game the system.[29]

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[27] USTA's Reply Comments, Attachment A at 22.

[28] *See* USTA's Comments at 34-37.

[29] *See* MCI at 14-15, Norsworthy, Appendix B at 31, ETI at 68-69, TRA at 6-7, ICA at 9.

Use of a forecasting method or a moving average would not be an administrative burden any more so than the annual "sanity check" advocated by Norsworthy (Appendix B at 30). Further, with the addition of the TFPRP, the data used in determining the TFP will be thoroughly documented, from publicly available sources, and can readily be verified for accuracy. The preparation of the TFPRP should not be any more of a burden than the Tariff Review Plan that is required with the annual access filings. It most certainly will be less time-consuming than this proceeding.

Claims that the LECs are capable of gaming the process by manipulating the TFP study are without merit for several reasons: First, these claims assume that all price cap LECs are in agreement on all the issues — which is not the case, as demonstrated by the comments filed in this proceeding. Second, since one or two LECs do not impact the results of a TFP study to any significant degree,[30] effective gaming would take a collusive effort of implausible dimensions involving all or most of the eleven LECs in the TFP study. Third, the presence of economy-wide indexes and the addition of a fixed X-Factor containing an input price differential allows for more gaming of the system than anything the LECs could possibly do to impact annual TFP results.

Since the price cap formula is meant to replicate a competitive marketplace, then it should be structured to operate in the same way. The goal is to predict what would happen in a competitive market, and have the price cap behave accordingly. GTE believes the

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[30] For example, in comparing the results of the simplified model to the original study, Christensen calculates a $\%\Delta TFP_{LEC}$ of 3.0 percent for the nine LECs in the original study, versus a $\%\Delta TFP_{LEC}$ of 2.9 percent using updated data for eleven LECs for the years 1988-93. See USTA's Comments, Attachment A, Table 8 at 31, and Table 9 at 32.